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IS 2100 (1970): Steel billets, bars and sections for
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Indian Standard
**SPECIFICATION FOR STEEL
BILLETS, BARS AND SECTIONS FOR BOILERS**
(*First Revision*)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR STEEL BILLETS, BARS AND SECTIONS FOR BOILERS (First Revision)

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Indian Standard

SPECIFICATION FOR STEEL BILLETS, BARS AND SECTIONS FOR BOILERS (*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 November 1970, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This Indian Standard was first published in 1962 and as a result of experience gained during these years, it has been decided to revise the Indian Standard. In this revision, the following modifications have been made:

- a) A uniform clause on manufacture has been adopted, and
- b) Ladle analysis has been specified and the permissible variations in check analysis indicated.

0.3 This standard contains clauses which call for agreement between the purchaser and the manufacturer. Such clauses are **3.1, 4.1, 5.1.1, 5.1.2** and **9.3**.

0.4 For the purpose of deciding whether a particular requirement[†] of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements for the following grades of steel billets, bars (other than rivets and stay) and sections for boilers:

Grade 1 — Billets, bars for forging;

Grade 2 — High tensile billets, bars for forgings and sections.

*Rules for rounding off numerical values (revised).

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of material shall conform to IS : 1387-1967*.

3. MANUFACTURE

3.1 Steel shall be manufactured by the open-hearth, electric, basic oxygen or a combination of these processes. In case any other process is employed by the manufacturer, prior approval of the purchaser should be obtained.

3.2 Steel shall be supplied killed.

4. CHEMICAL COMPOSITION

4.1 The ladle analysis of steel when made in accordance with IS : 228-1959† shall be as given in Table 1.

TABLE 1 CHEMICAL COMPOSITION

GRADE	DESIGNATION	CONSTITUENT, PERCENT			
		*Carbon	Manganese	Sulphur Max	Phosphorus Max
(1)	(2)	(3)	(4)	(5)	(6)
1	Cl5Mn ⁷⁵	0.10 to 0.20	0.60 to 0.90	0.050	0.050
2	20Mn2	0.16 to 0.24	1.30 to 1.70	0.050	0.050

NOTE — When the steel is silicon killed, the product analysis shall show a minimum of 0.10 percent silicon. When the steel is aluminium killed or killed with a combination of aluminium and silicon, the requirement regarding minimum silicon content shall not apply.

*For sizes above 25 mm thickness, the carbon content shall be subject to agreement between the purchaser and the manufacturer.

4.2 Product Analysis — Permissible variations in case of product analysis, from the ladle analysis, shall be as follows:

Constituent	Variation Over the Specified Limit Percent
Carbon	± 0.02
Manganese	
Up to 0.90	± 0.04
From 1.30 up to and including 1.70	± 0.06
Sulphur	+ 0.005
Phosphorus	+ 0.005

NOTE — Variations shall not be applicable both over and under the specified limits for several determinations in a heat.

*General requirements for the supply of metallurgical materials (first revision).

†Methods of chemical analysis of pig iron, cast iron and plain carbon and low-alloy steels (revised). (Since revised and split into various parts).

4.2.1 Residual copper shall not exceed 0.10 percent in both the grades.

5. FREEDOM FROM DEFECTS

5.1 The material shall be cleanly rolled to the dimensions specified. The finished material shall be free from excessive segregation or impurities and from cracks; surface flaws; laminations; rough, jagged and imperfect edges; and other harmful defects. Hammer dressing, patching or welding of defects is prohibited.

5.1.1 The billets may be conditioned to remove injurious surface defects provided the depth of conditioning does not exceed 1 mm for every 16 mm of dimensions concerned up to a maximum depth of 19 mm and provided that the width of conditioning is at least four times its greatest depth, except that in the case of sections where the width is at least twice the thickness, the depth of conditioning on the wide surface may exceed this allowance by 50 percent up to a maximum depth of 19 mm. The maximum depth of conditioning two parallel sides at opposite locations shall not exceed one and one-half times the maximum allowed for one side. In special cases, particularly where it is necessary on large sizes and where it is not injurious, greater depth of conditioning may be permitted by special agreement between the purchaser and the manufacturer.

5.1.2 The ends of the billets shall be cropped by sawing, shearing or flame cutting, unless otherwise specified by the purchaser.

6. TOLERANCES

6.1 Diameter — The tolerance on diameter of round bars shall be as follows:

<i>Size</i>		<i>Tolerance</i>		<i>Total Margin</i>
Over	Up to and Including	Minus	Plus	
mm	mm	mm	mm	mm
—	25	0.5	0.5	1.0
25	50	0.75	0.75	1.5
50	80	1.0	1.0	2.0
80	100	1.25	1.25	2.5
100	125	1.5	1.5	3.0
125	160	2.0	2.0	4.0
160	—	2.5	2.5	5.0

6.2 The tolerances for billets shall be as follows:

<i>Size of Billets</i>	<i>Tolerance</i>
Below 100 mm	± 1.5 mm
100 to 125 mm	$+ 5.0$ mm $- 1.5$ mm

6.3 The tolerances for sections shall be as given in IS : 1852-1967*.

6.4 When special plus and minus tolerances are required, the sum of such tolerances shall be specified as not less than the total tolerances given in 6.1.

6.5 Weight — The tolerance on weight for round bars shall be as follows:

<i>Size</i>	<i>Tolerance on Calculated Weight</i>		<i>Total Margin</i>
	<i>Minus Percent</i>	<i>Plus Percent</i>	<i>Percent</i>
Up to and including 8.0	4	4	8
Over 8.0	2½	2½	5

7. CALCULATION OF WEIGHT

7.1 The weight of billets, bars and sections shall be calculated on the basis that steel weighs 7.85 g/cm³.

8. SELECTION OF TEST SAMPLES

8.1 Test samples shall be selected by the purchaser from the cuttings of the material.

8.2 Test samples shall not be detached from the material except in the presence or with the approval of the purchaser.

8.3 Before the test samples are selected, full particulars regarding cast number, size and weight of the material from each cast shall be furnished to the purchaser by the manufacturer.

8.4 The test samples shall not be annealed or otherwise subjected to heat treatment unless the material from which they are cut is similarly treated in which case the test samples shall be similarly and simultaneously treated with the material, before testing. Any slight straightening of test samples which may be required shall be done cold.

*Specification for rolling and cutting tolerances for hot-rolled steel products (first revision).

9. TENSILE TEST

9.1 Two tensile tests shall be taken from each cast or from every 25 tonnes of material rolled, whichever is less. Where billets, bars and sections of more than one thickness are rolled from the same cast, one additional tensile test shall be made from the material in each class of product for each variation in thickness of 6 mm above or below the thickness for which the test piece was first selected.

9.2 The tensile strength, yield stress and percentage elongation shall, when determined in accordance with IS:1608-1960*, conform to the requirements given in Table 2 and the test piece shall be cut lengthwise.

TABLE 2 MECHANICAL PROPERTIES

GRADE OF MATERIAL	TENSILE STRENGTH	YIELD STRESS, Min, OF TENSILE STRENGTH	ELONGATION, Min (GAUGE LENGTH 5.65√A)
			Percent
	kgf/mm ²	Percent	Percent
1	42 to 50	55	25
2	52 to 62	50	20

9.2.1 Should a tensile test piece break outside the middle half of its gauge length and the percentage elongation obtained is less than that specified, the test may be discarded at the manufacturer's option and another test made from the same bar.

9.2.2 Billets — One billet from each cast, one end of a billet or a portion which has been cut off from the billet, shall be drawn down to 50 percent of the original sectional area in the presence of the purchaser, followed by normalizing or heat treatment before the test pieces are cut therefrom.

9.2.3 Bars — Round and square bars may be tested full size as rolled or they may be turned down to a convenient size. Proportional test piece with gauge length $5.65\sqrt{A}$ shall be used for tensile testing.

9.2.4 Sections — Wherever practicable, the rolled surface shall be retained on the two opposite sides of the test pieces. Proportional test piece with gauge length $5.65\sqrt{A}$ shall be used for tensile testing.

9.3 Subject to mutual agreement between the purchaser and the manufacturer, the manufacturer shall guarantee the required yield stress at any higher temperature.

*Method for tensile testing of steel products other than sheet, strip, wire and tube. Since

10. BEND TEST

10.1 One bend test shall be made for each tensile test.

10.2 Bend test shall be carried out in accordance with IS: 1599-1960*.

10.3 The test pieces shall be sheared or cut lengthwise from sections and bars and shall be 230 mm long and, when the section permits, shall be not less than 40 mm wide. For small sections and bars, the whole section may be used. For sections having flanges less than 50 mm wide, it is permissible to use the whole section for test after flattening. The rough edge or arris caused by cutting or shearing may be removed by filing, grinding or machining but the test pieces shall receive no other preparation.

10.3.1 In the case of billets, the test piece shall be 230 mm long and 32 mm square with 1.5 mm radius at the edges.

10.4 For bend test (except in the case of round bars 25 mm diameter and under, and billets) the test pieces, when cold, shall withstand without fracture being doubled over through 180° either by pressure or by slow and steady blows from a hammer till the internal diameter is not greater than twice the thickness or diameter of the test piece.

10.4.1 In the case of round bars 25 mm in diameter and under, the internal diameter of the bend shall be not greater than the diameter of the bar.

10.4.2 The test piece for billets shall withstand being bent cold by direct pressure from a tool 40 mm wide, the end having a radius of 20 mm until the sides of the test piece are parallel. The ends of the test piece shall then be brought together without fracture by direct pressure.

11. RETESTS

11.1 Should any one of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected for testing in respect of each failure. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test samples shall be considered as not having complied with this standard.

12. MARKING

12.1 Every piece of steel (with the exception of small bars and pieces which shall be supplied in securely packed bundles) shall be legibly

*Method for bend test for steel products other than sheet, strip, wire and tube.

marked with the following information:

- a) Manufacturer's name or trade-mark, if any;
- b) Number of other identification mark by which they can be traced to the cast of steel from which they were made; and
- c) Grade (*see* 1.1).

12.1.1 In the case of such bars and small pieces as are securely bundled, a metal tag shall be attached to each bundle and marked as specified in 12.1.

12.1.2 The material may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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